Integrity ★ Service ★ Excellence

Energy, Power and Propulsion Sciences

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John D. Schmisseur

Chair, Energy Power and Propulsion Sciences Department

AFOSR/RTE

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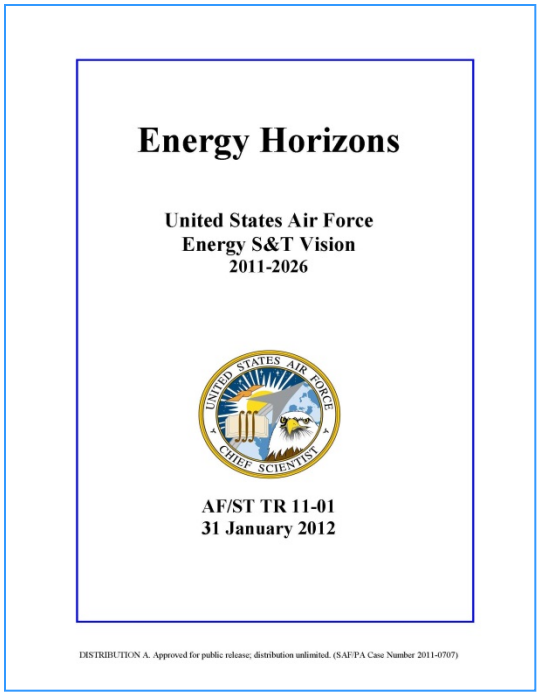
An Energy-Driven Environment



"Assuring Energy Availability and Efficiency Is Central to the Growth of the Aeronautics Enterprise …"

"Energy is essential to all Air Force (AF) missions. … a vector to increase energy supply, reduce demand, and change our culture …"

"… there are increasing pressures …to simultaneously conserve fuel as well as seek new sources of energy …"

Challenges & Opportunities

The Air Force Consumes 60% of the fuel used by the DoD
80% of which is aviation fuel
- 2006 SAB Study

Aerial Refueling Costs are estimated at $35-40/gallon.
- Congressional Research Service Report R42558

Addressing system level challenges requires contributions from many disciplines and emphasized multidisciplinary integration

The objective of the Energy, Power and Propulsion Sciences Department is to lead the discovery, refinement and transition of innovative science that *provides the foundation for revolutionary new capabilities enabling energy efficiency and security*

The RTE Team

Laura Plati MURI

Chiping Li
Energy Conversion and Combustion Sciences,

John Schmisseur
Aerothermodynamics

Pat Bradshaw
Human Performance and Biosystems

Mike Berman
Molecular Dynamics, Theoretical Chemistry

Mitat Birkan
Space Power and Propulsion

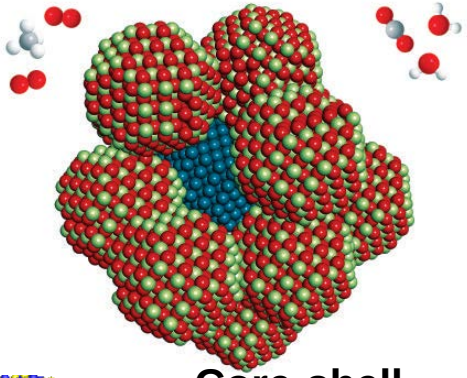
Raheem Lawal
STTR

Chakila Tillie
Detailed to International Office

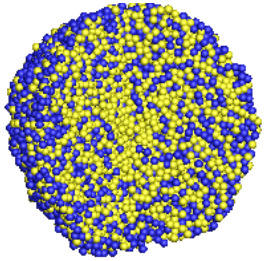
RTE Scientific Emphasis

Energy Extraction and Storage:

- Storage in chemical structures
- Nanoenergetics
- Fuel Characterization
- Microbial-generated
- Energy Recycling

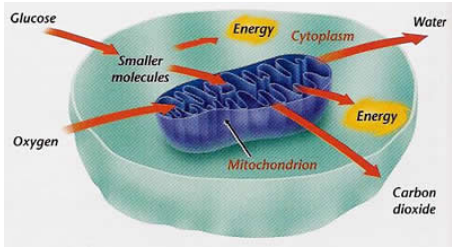


Core-shell nanocatalyst



Nanoenergetic Particles

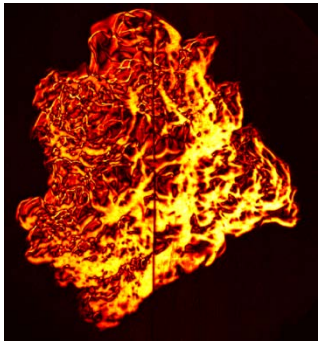
Photoelectric Stimulation of Mitochondrial Metabolism

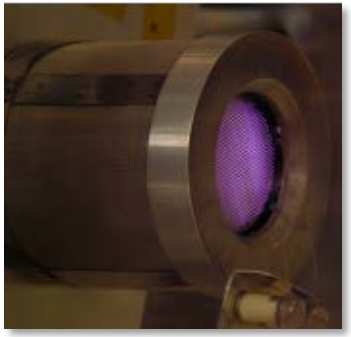


Energy Conversion and Utilization:

- Energy transfer mechanisms
- Flame dynamics and properties
- Combustion chemistry
- Plasma dynamics
- Aerothermodynamics
- Alternative Conversion

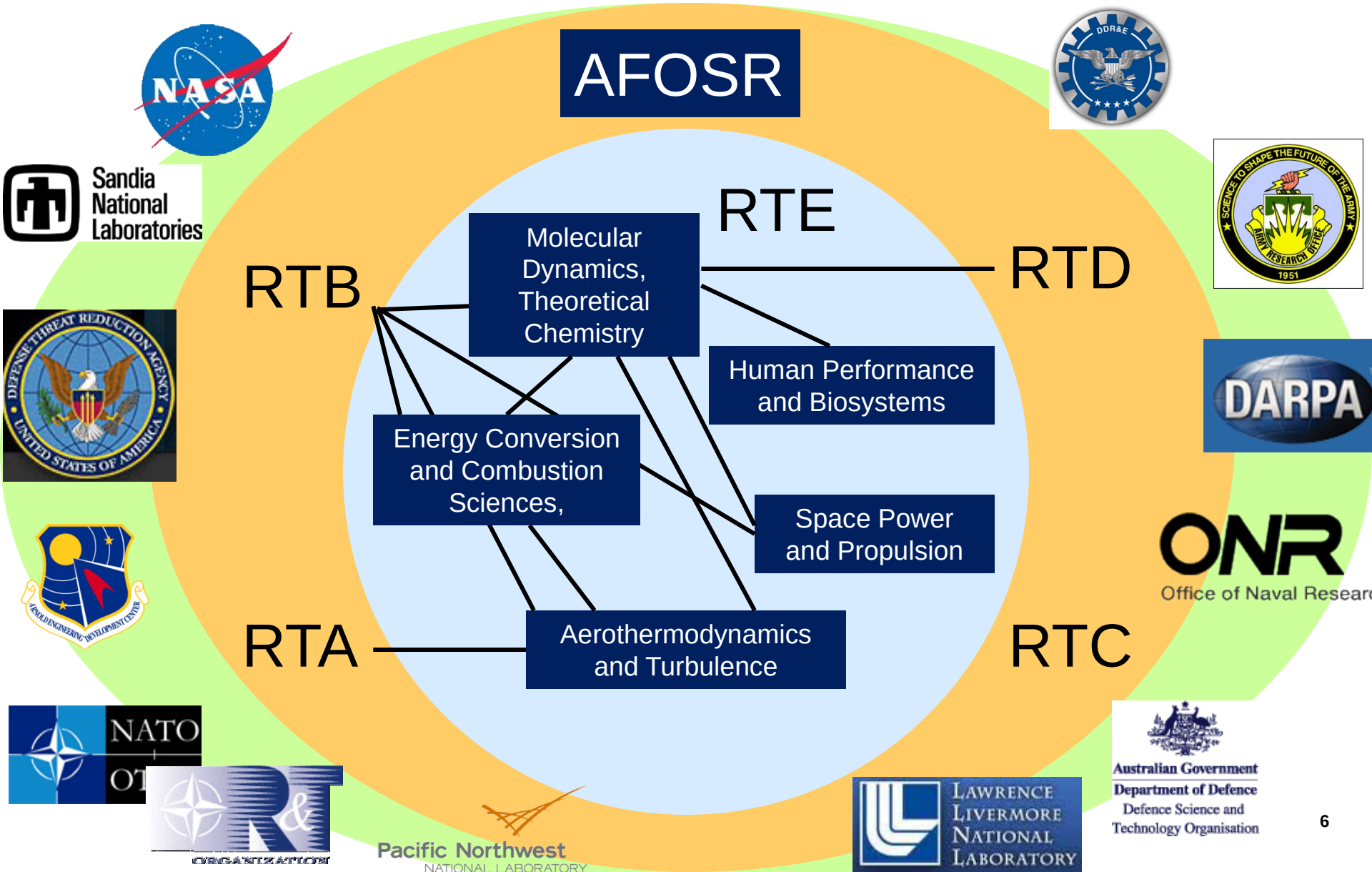
Turbulent Flame Dynamics





Micro-scale plasma source

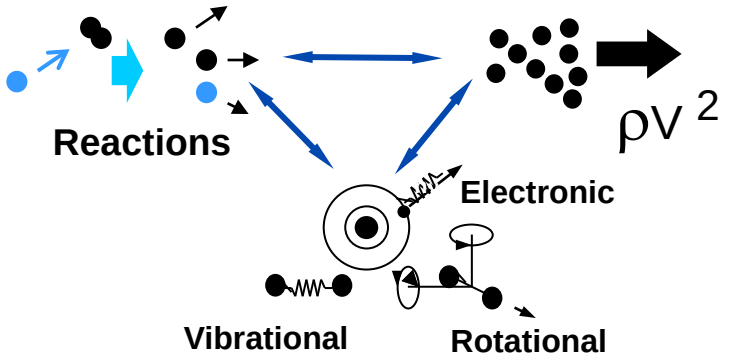
Strong Emphasis Multi-Portfolio Collaboration



2013 Basic Research Initiative
Foundations of Energy Transfer in Multi-Physics Flow Phenomena

Establish the multidisciplinary scientific foundation for innovative approaches to *inherent* flow control

- Identify fundamental processes
- Exploit energy transfer in shaping macroscopic flow behavior



Bridging Multiple Portfolios

- Aerothermodynamics and Turbulence
- Energy Conversion and Combustion Sciences
- Molecular Dynamics and Theoretical Chemistry

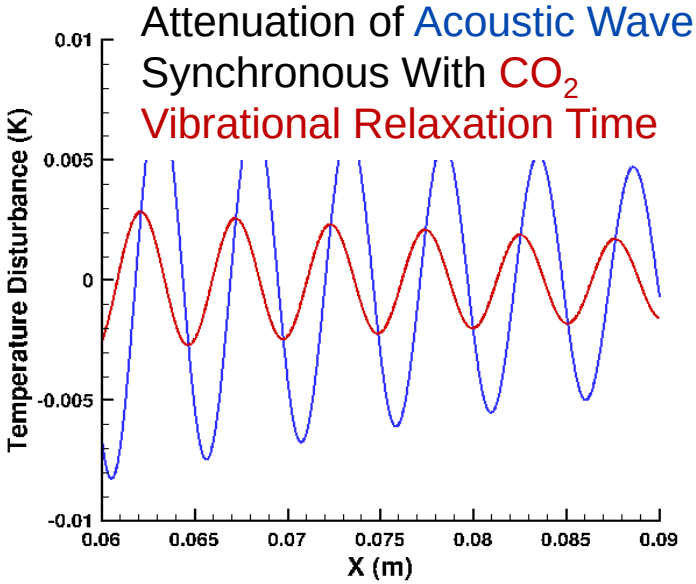
RTE

- Flow Interactions and Control

RTA

- Plasma and Electroenergetic Physics

RTB



BRI Process has driven exchange of PIs across portfolios

Interactions within AFOSR Via BRIs

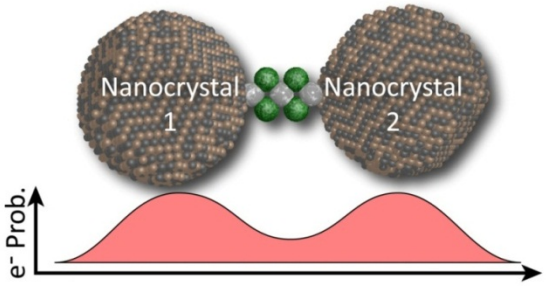
Nanoscale Building Blocks for Novel Materials
Berman with RTD (De Long)

Use nanoscale structures as building blocks to make novel materials with new properties for energy manipulation

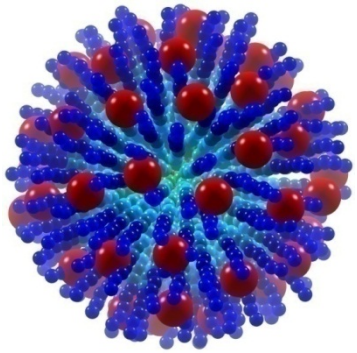
Plasma-Surface Interactions
Berman with RTB (Luginsland)

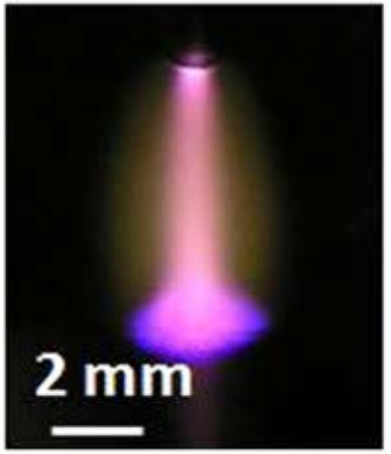
Plasma-surface interactions for enabling novel and energy-efficient means of protecting or creating materials

Chemical linkers



Bio-based linkers





National Hypersonic Science Centers

Joint AFOSR-NASA Fundamental Aeronautics Sponsored National Hypersonic Science Centers Extend Collaboration Initiated Under the Foundational Research Plan

Total of $30M in invested over 5 years

More than 20 Universities Supported via Centers

NHSC: Hypersonic Laminar-Turbulent Transition, Texas A&M

NHSC: Hypersonic Materials and Structures, Teledyne Scientific and Imaging

NHSC: Center for Hypersonic Combined Cycle Flow Physics, Uva

The RTE Team

- Relevant, game-changing Science addressing energy *extraction, storage, conversion and utilization*
- Strong emphasis on partnerships and collaborations